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CRANIOTOMY ALONE RESULTS IN DEFAULT MODE NETWORK DYSFUNCTION IN THE IMMATURE RAT

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It remains controversial whether rodents with a craniotomy-only are required, or even appropriate to serve as a sham group to control for the effect of surgery after experimental TBI. Published data show significant molecular and behavioral changes that occur due to craniotomy compared to naïve controls, indicating that craniotomy alone likely constitutes a brain insult. We hypothesized that these confounding effects of craniotomy are also accompanied with alterations in neural circuit dysfunction. We tested this by acquiring resting state functional-MRI data from male, 23 day-old Sprague Dawley rat pups at day 4 post-craniotomy (3mm diameter, -3mm, +4mm left-lateral; intact dura) as well as from age-matched, naïve controls with no craniotomy but with time-matched exposure to isoflurane anesthesia (n=5/group). Imaging data were acquired on a 7 T Bruker spectrometer using a single-shot, gradient-echo sequence, echo/repetition time: 20/1000ms, 300 repetitions, 128×128 matrix, 30×30mm field-of-view and 1mm slice-thickness). After typical preprocessing of the time-series data, voxel-wise functional connectivity analysis was then performed by calculating Pearson correlation coefficients between all brain voxels. The Root Mean Square of the correlation values for each voxel were calculated as an index of global functional connectivity (fc), clusterized for the presence of 30 voxels or more. Large scale, significant (p<0.01) differences in fc were found between the two groups following group ANOVA. Center of mass for the peaks of the clusters that survived statistical correction for multi voxel comparison were located predominantly in regions previously assigned to the rodent default mode network: bilaterally in auditory, temporal association, and primary visual cortex, and in right retrosplenial cortex and hippocampus. These network alterations provide additional evidence to support the idea that craniotomy-alone constitutes a brain injury, and that it might not always serve as an appropriate control. Funding: R01NS27544, R01NS091222, UCLA Easton Labs for Brain Injury, UCLA Steve Tisch BrainSPORT program, UCLA BIRC.

Keywords: Craniotomy, Default mode network, Developing Brain, MRI, Experimental model of TBI

A13-16

RELATIONSHIP BETWEEN MICROVASCULAR FUNCTION AND REGIONAL BRAIN VOLUMES AFTER CHRONIC TBI

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Traumatic Cerebral Vascular Injury (TCVI) is a universal feature of traumatic brain injury (TBI) and likely contributes to TBI-related disability. Prior studies have shown a significant decrease in whole brain, gray and white matter cerebrovascular reactivity (CVR) in TBI subjects. The relationship between regional CVR measures and brain parenchyma integrity is unknown. To investigate whether TCVI correlates with brain

parenchymal volume loss, analysis was performed on chronic TBI subjects and healthy controls. TCVI was measured via Blood Oxygen Level Dependent magnetic resonance imaging (MRI-BOLD) with hypercapnia challenge to generate CVR maps, as well as arterial spin labeling (ASL) to generate cerebral blood flow (CBF) maps. Cerebral volumes were calculated with the Freesurfer image analysis suite. The segmentation maps were imported into MATLAB and superimposed onto CBF and CVR maps to calculate mean values for each region of interest (ROI). Volume measurements were compared to CBF and CVR values within each ROI. CVR was significantly decreased in multiple subcortical ROIs in the chronic TBI subjects relative to healthy controls (p<0.001), while CBF was not. TBI subjects exhibited significantly more ROIs with reduced volume and cortical thickness (z-score<-2.5, p<0.05). Group level analysis did not reveal significant volume changes in any particular ROI between the TBI and healthy control groups. Regional volumetric changes, CBF, and CVR were not significantly correlated over multiple ROIs. Cortical gyri with a substantial reduction in thickness (z-score<-2.5) in TBI subjects did not show a concurrent abnormal CBF or CVR reduction (z-score>-2.5). This suggests that regional deficits in CBF and CVR in chronic TBI reflect direct vascular injury and dysfunction, and are not a consequence of neural injury. Vascular and neuronal injuries represent distinct TBI endophenotypes, which warrant independent study to further understand their contributions to TBI.

Keywords: MRI, Cerebral Vascular Reactivity, Chronic TBI, MRI-BOLD, Arterial Spin Labeling

A14 INTRACRANIAL PRESSURE

A14-01

MINNESOTA EXTERNAL VENTRICULAR DRAIN GRADING SYSTEM

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Background: The safety and accuracy of EVD placements remain a challenge in daily practice and publications. A need to develop a rapid and standardized EVD grading system in neurosurgical practice is desired. We developed a three-dimensional Minnesota EVD grading system that account for the number of times the catheter crosses the ependyma, the trajectory and the depth of the catheter tip with respect to Foramen of Monro (FOM). Our study aims to compare the strengths and weaknesses of Minnesota EVD grading system against previously proposed EVD grading systems.

Methods: CT scans of 104 patients who underwent a ventriculostomy were reviewed retrospectively. Three resident physicians were chosen to be the raters. Pre-procedure CT scans were distributed to the graders to estimate the level of difficulty of a catheter placement (e.g. Easy, Intermediate, Hard). Then post-procedural CT scans were given to the raters to grade using the Minnesota EVD scale, O'Leary's, Huyette's, Karkala's and Janson's grading systems. All the scans were distributed to the raters in a random order. Intraclass coefficients were calculated to determine the inter- and intra-rater reliabilities of each scale. The efficiency and practicality of the grading scales were compared by measuring the time required to grade each scan and the frequency of specialized software use during the grading session, respectively.

Results: Inter-rater reliability of Karkala's, Janson's and Minnesota EVD grading system were similar and higher than O'Leary's and Huyette's scales. Minnesota EVD system has the highest intra-rater reliability compared to the rest of the grading scales. Furthermore, Minnesota EVD grading system predicted 76.7% of the difficulty score which is higher than all the 4 grading scales combined.